Characterization of the Mid Summer Drought in the Central Valley of Costa Rica, Central America

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Abstract: The IAS region is characterized by climate features of unique nature, one of them is the Mid-Summer Drought (MSD), "veranillo" or "canícula" in Spanish, an atmospheric attribute rarely observed in tropical regions. On the Pacific slope of Central America, the precipitation annual cycle is characterized by two rainfall maxima in June and September-October, an extended dry season from November to May, and a shorter reduced precipitation period during July–August (MSD) (**Fig. 1a**) , during July, the magnitude of trade winds increase and this is associated also with the Caribbean Low Level Jet (**Fig. 1b**) (Amador, 2008), but characterization of these features using monthly data is difficult. In this work, three daily gauge stations records, e.g. La Argentina, Fabio Baudrit and Juan Santamaria, located in the Central Valley of Costa Rica were studied to characterize the MSD from 1937 to 2012 (**Fig. 2**). Among the aspects considered are the MSD Start (**July 1**), Timing (**July 21**), End (**August 9**), Intensity (**7.2 mm/day**), and Precipitation at the Minimum (**4.1 mm**) (**Fig. 3**). The modulation and seasonal predictability (**Table 1**) of these aspects by climate variability sources as Equatorial Eastern Pacific and Tropical North Atlantic was lately explored, including their interannual and decadal variability. Atlantic SST variability didn't show statistical significant relationships. Particular study cases were selected to observe the synoptic conditions around Central America (**Fig. 4**) for different atmospheric variables, that because MSD signal strongly impact social and economic life in the region like energy (Puente de Mulas, Belen, Virilla, La Garita and Nuestro Amo dams are located there) and the agriculture sector (around 50% of the national coffee production). Additionally, Central Valley of Costa Rica, specially the Tarcoles river basin (**Fig. 2a**), hosts most of the Costa Rican population with the higher level of exposition and vulnerability to hydro-meteorological hazards, 53% of the Costa Rican population lives in that basin.

Some references:

-Alfaro, E., 2002. Some Characteristics of the Annual Precipitation Cycle in Central America and their Relationships with its Surrounding Tropical Oceans. *Tópicos Meteorológicos y Oceanográficos*, 9(2), 88-103.

-Amador, J., 2008. The Intra-Americas Seas Low-Level Jet (IALLJ): Overview and Future Research. *Ann. N. Y. Acad. Sci.,* 1146(1), 153-188.

-Magaña V., J. Amador and S. Medina. 1999. The Midsummer Drought over Mexico and Central America, *Journal of Climate*, 12, 1577-1588.

-Taylor, M. and E. Alfaro, 2005. Climate of Central America and the Caribbean. In: *Encyclopedia of World Climatology*. John E. Oliver (ed.), Springer, Netherlands. 183-189.
-http://www.esrl.noaa.gov/psd/data/reanalysis/reanalysis.shtml

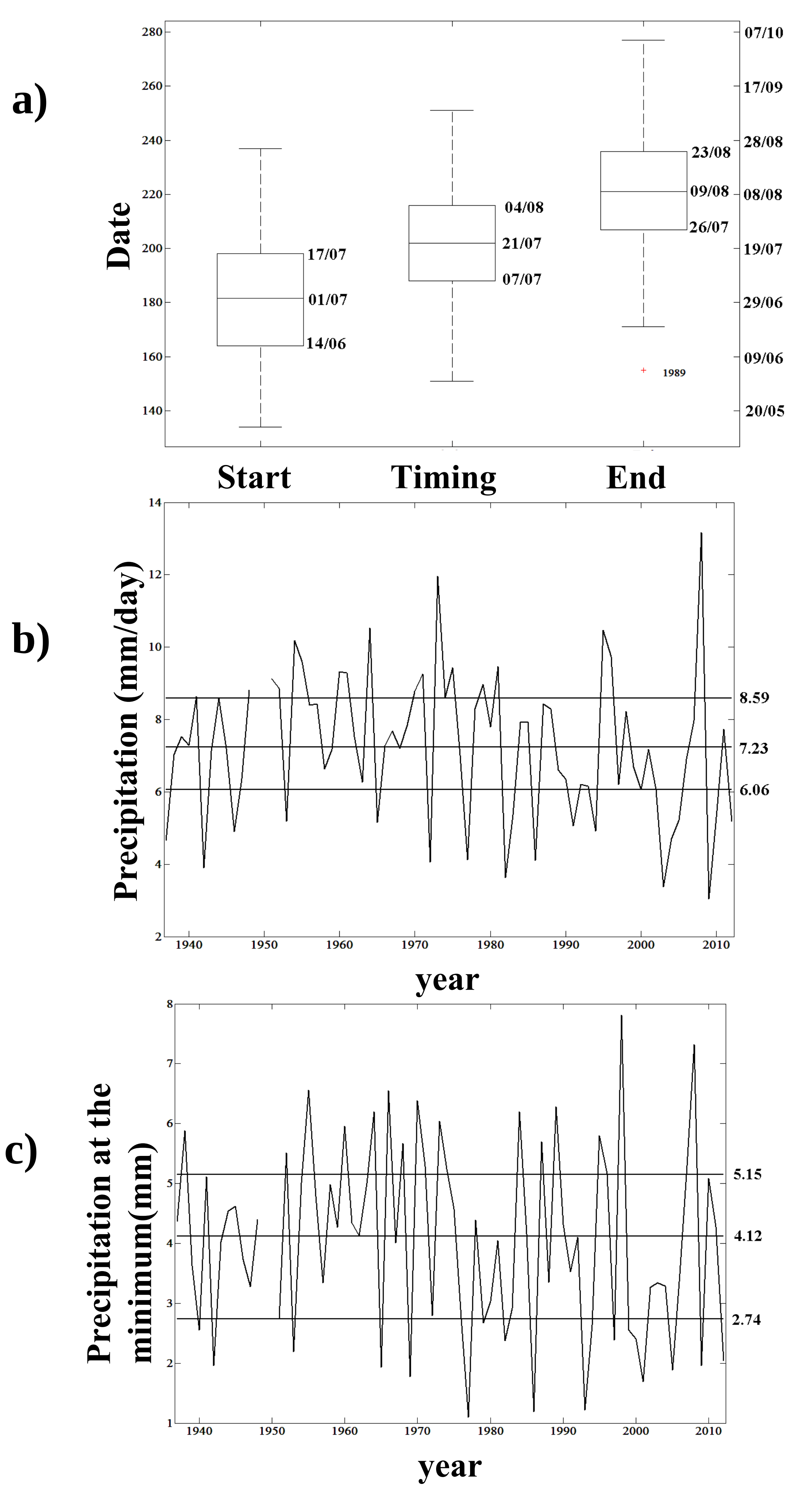


Fig. 3 – **a)** Box plot for the start, timing and end of the events considered, whiskers are P75+1.5*IQR and P25-1.5*IQR, Julian and Gregorian dates are at the left and right y-axis, respectively **b)** Annual time series for the intensity and **c)** for the precipitation at the minimum, horizontal lines are for P25, median and P75.

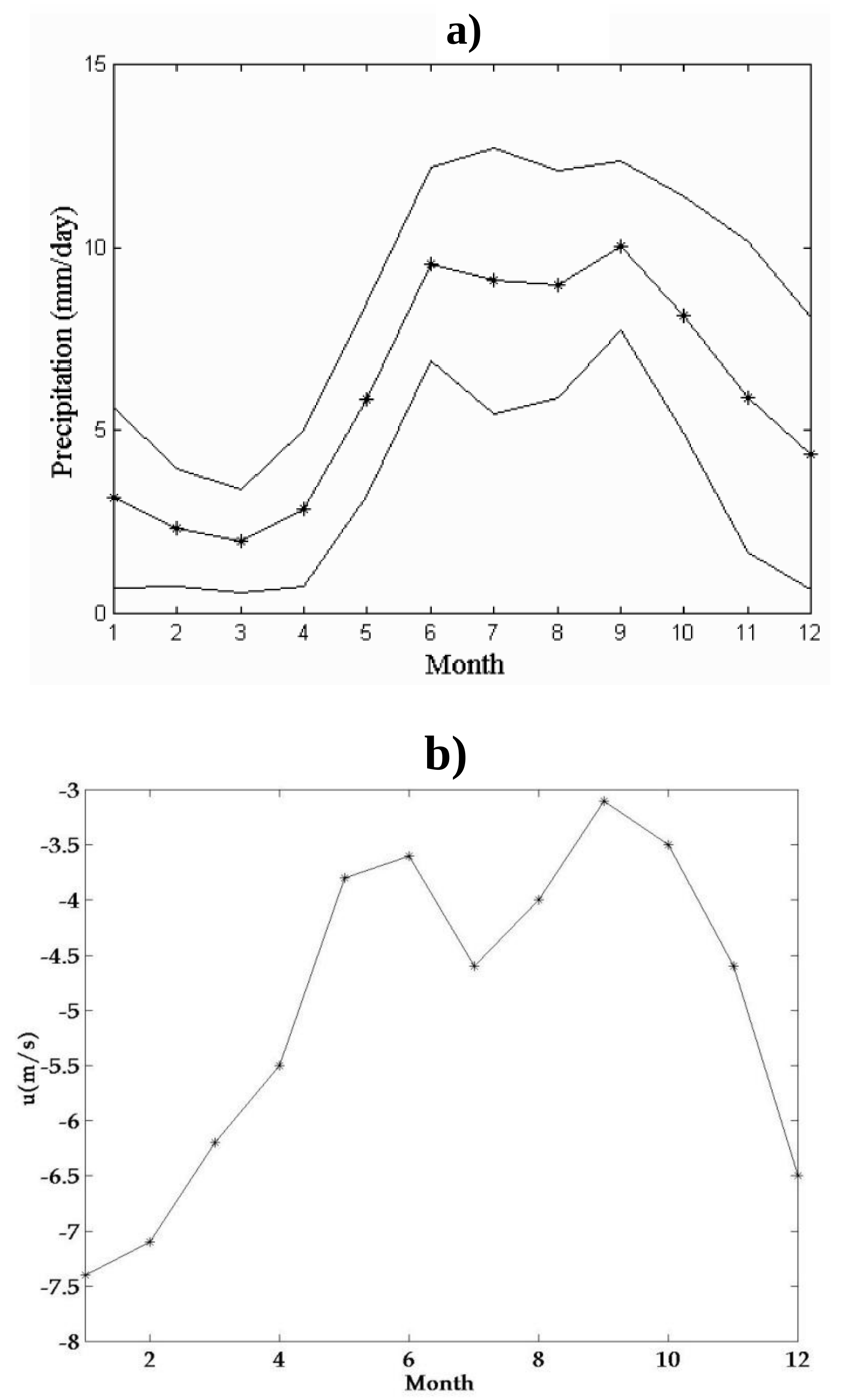
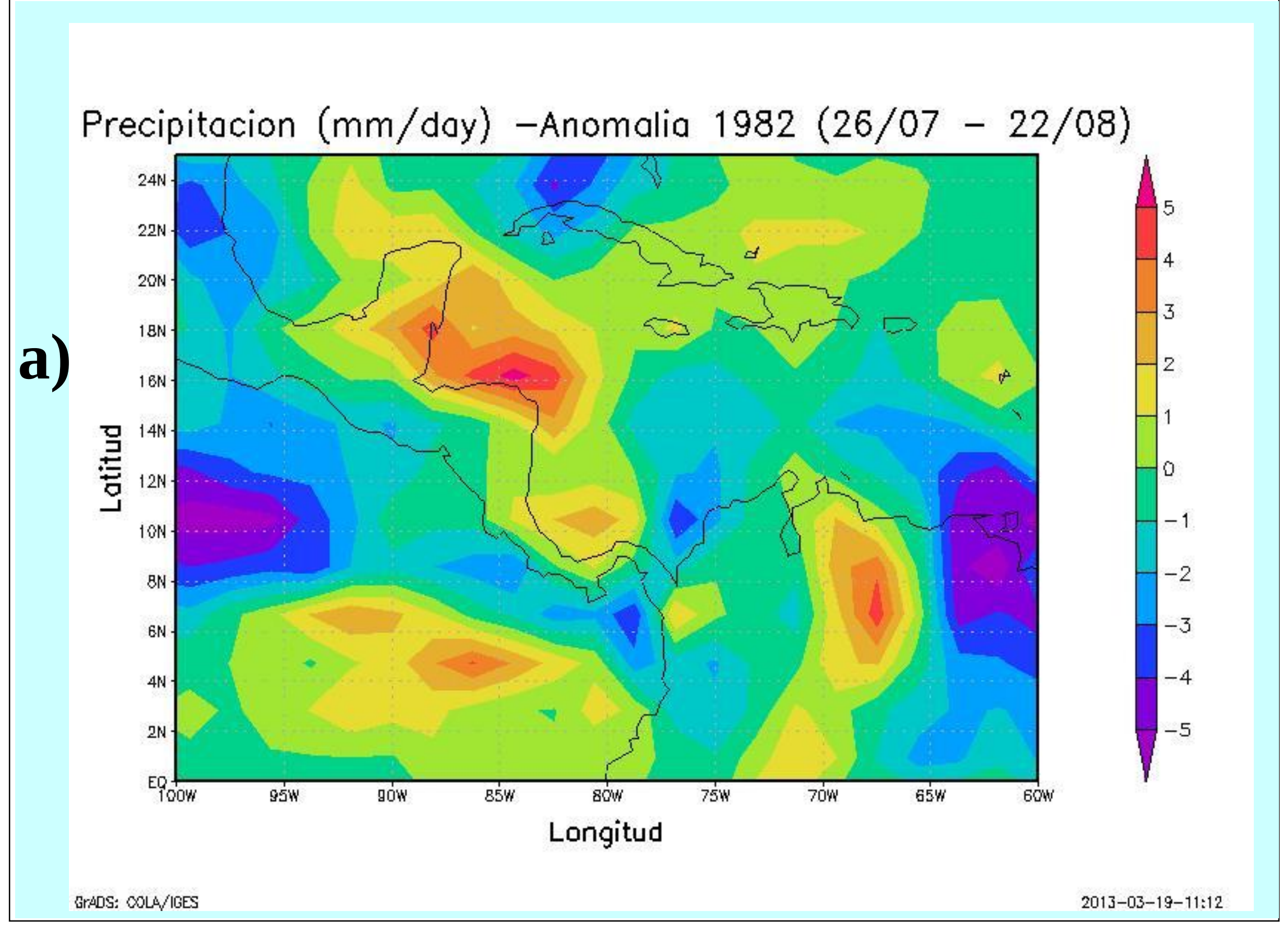


Fig. 1 – **a)** Line with asterisk is the first (dominant) EOF of rainfall annual cycle pattern from 337 points over or very close to land in Central America, covering 78.0-95.0°W, 7.5-21.5°N. Bands show one standard deviation (solid lines). The sources of these data are described in Magaña *et al.* (1999), (Alfaro, 2002), **b)** Zonal Wind annual cycle at surface, u(m/s), Juan Santamaria station (**Fig. 2**) (Taylor y Alfaro, 2005).

Minimum				
Niño 3.4 June		***BN***	***N***	***AN***
	BN	13(3)***	30(7)	57(13)**
	N	26(7)	52(14)***	22(6)*
	AN	62(15)***	21(5)*	17(4)**

Intensity				
Niño 3.4 June		***BN***	***N***	***AN***
	BN	17(4)**	26(6)*	57(13)**
	N	22(6)*	48(13)**	30(8)
	AN	62(15)***	21(5)*	17(4)**

Table 1. – Relative frequency (percentages) Contingency Tables between June Niño 3.4 (rows) and the precipitation at the minimum of the events (top) and the intensity (bottom) (columns). *, **, and *** are for α = 0.1, 0.05 and 0.01, significance levels, respectively. Values in parenthesis are for absolute frequencies. Warm (cool) ENSO events tend to be associated with dry (wet) MSD conditions. Among the BN category years in intensity are 2009, 2003, 1982, 1942, 1972, 1986 and 1977.



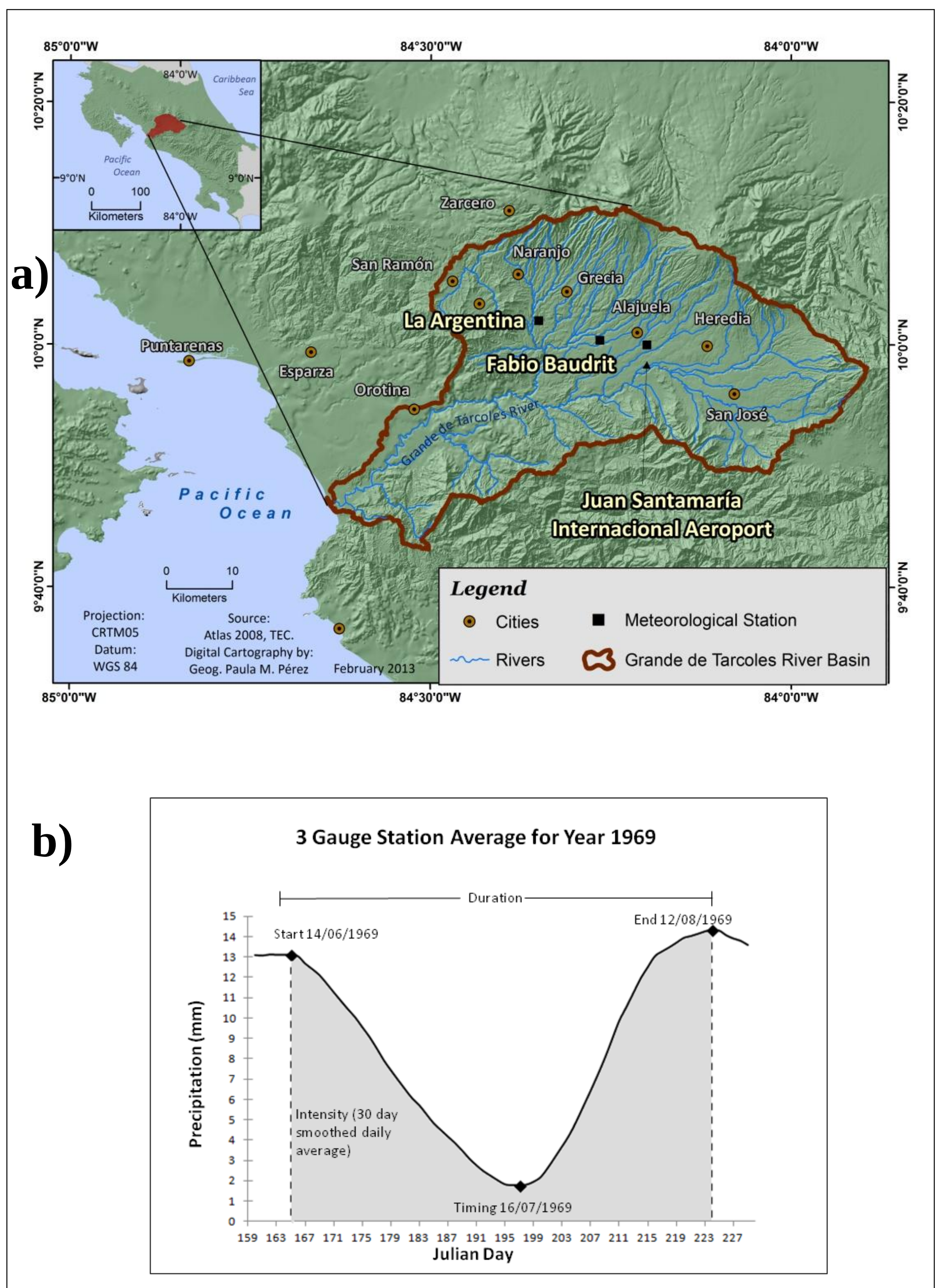


Fig. 2 – **a)** Location of the three gauge stations used at the west of the Costa Rican Central Valley. **b)** Individual records were smoothed with a triangular moving average of 30 days, then, the daily average using the three records was calculated to produce a precipitation index. The figure shows the characteristics that were considered using 1969 as an example. 74 cases were studied, from 1937 to 2012. 1949 and 1950 were not considered for their quantity of missing data.

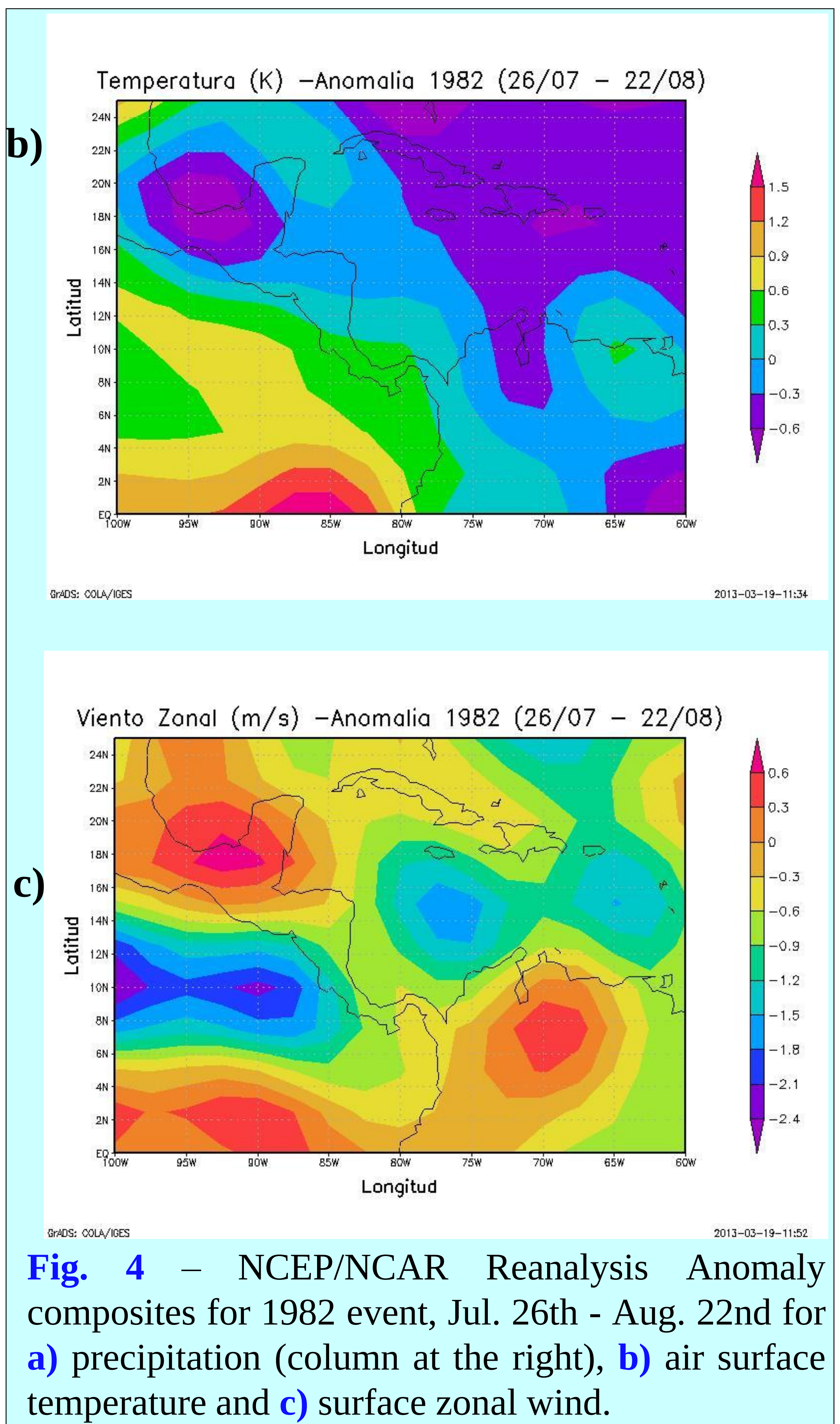


Fig. 4 – NCEP/NCAR Reanalysis Anomaly composites for 1982 event, Jul. 26th - Aug. 22nd for **a)** precipitation (column at the right), **b)** air surface temperature and **c)** surface zonal wind.

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